4 Benefit Analysis

What benefits will accrue by proceeding with this program?

4.1 Overview of Benefits

In order to make informed decisions about investing in a GIS program that meets the needs of a wide array of public and private organizations throughout Maine, it is necessary to look at how the application of GIS will affect specific business and decision-making processes and what the types of benefits will be.

4.1.1 Types of Benefits

There are five categories of benefits that can be realized through the application of GIS. These are:

- Task Efficiencies
- Cost Avoidance
- Improvements and Additions to Service
- Intangible Benefits
- Leveraged Investment

Task Efficiencies – Task efficiencies occur when the introduction of GIS into a business process results in time savings, or even elimination of tasks. One example of this is a local assessing department using parcel data to compile an abutters list. Another example is the use of GIS in siting public facilities such as schools. By compiling spatial and associated non-spatial data in GIS, multiple criteria associated with site selection can be evaluated much more quickly than is possible when data is dispersed and in different formats.

Cost Avoidance – Cost avoidance can be achieved when the application of GIS results in decisions or actions that enable an organization to save money it would otherwise have spent on business as usual. An example of cost avoidance is the application of GIS for vehicle routing. Using GIS for bus routing, for example, can result in a significant reduction of vehicle miles traveled and fuel used.

Without GIS, water models utilize approximations of the water distribution system that do not match with their true locations, and therefore both the inputs to and the outputs of the model are difficult to correlate with actual conditions. With GIS, model inputs can be calculated from mapped data, such as population density. In addition, model output can be mapped in meaningful ways, such as color coding pipes based on pressure against a basemap of topographic relief.

Improvements and Additions to Service – The application of GIS into an organization can be an enabler, providing a town or department with tools to provide services that would not be possible without the technology. Disaster preparedness and management is

an example of improved service capabilities. By having important infrastructure, environmental and demographic information compiled in GIS, officials can better respond when disasters occur, such as the 1998 ice storm in Maine.

Another example of improvements to service can be seen in the use of GIS for water modeling. Without GIS, models provide approximations of water flows and demands based on estimated information about the water network that are programmed into the model. With GIS the model can utilize specific information about the locations of water assets, providing more accurate results and improved ability to serve the public's demand for water and water quality.

Intangible Benefits - Intangible benefits can not be quantified in monetary terms, but are nonetheless important in the justification of a GIS. For example, many municipalities maintain paper data and plans that are old and are quickly deteriorating over time. By converting these data to GIS format historic information that only one or two staff may maintain in their heads is documented and made available to many more people to use and understand. This availability and accessibility of information may provide huge value by improving moral, inciting creativity and facilitating the sharing of ideas. Additional examples of intangible benefits include improved image of the public organization and improved customer service due to an improved ability to respond to information requests.

Improved decision-making is another type of intangible benefit. For example, if GIS is used for the analysis of land acquisition for open space, it is possible to consider spatial relationships between a variety of factors such as zoning, land ownership, accessibility via roads or public paths, cost of land, and potential use based on topography and land cover. By enabling the synthesis of multiple spatial issues into a single picture, GIS can optimize the decision making process.

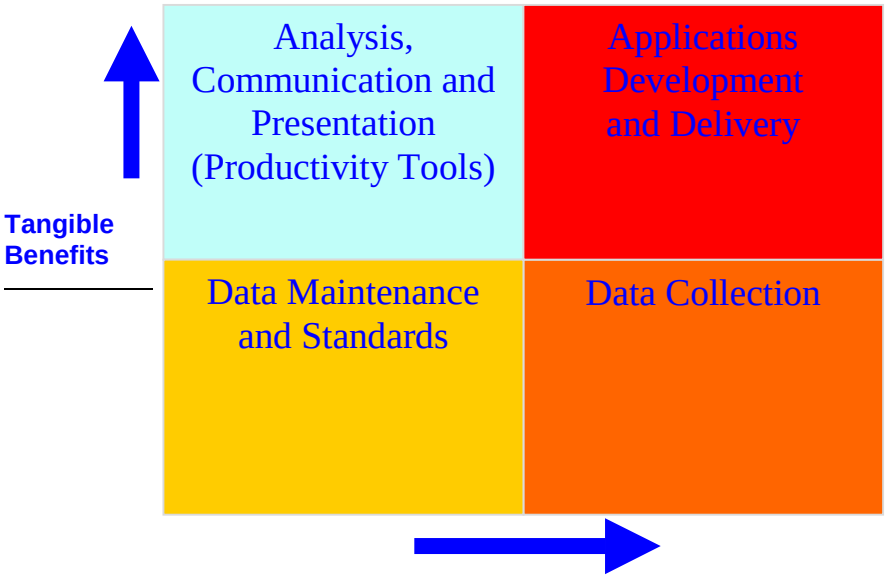
Leveraged Investment - This category relates to benefits that can be realized once an initial investment is made. For example, there are grant programs such as the United States Geological Survey (USGS) National Aerial Photo Program (NAPP) program that provide matching funds for local investments in GIS data development. By providing funding to support participation in this grant program, two dollars of product is realized for every $1 of money invested by Maine.

An additional example of this type of benefit occurs when access to an investment in GIS data and technology is given to additional end users. For example, an organization such as a utility may develop GIS data for a region that is relevant to towns, counties and state agencies. If all of those organizations are given access to the data they can utilize the data for analysis and decision-making, and will accrue benefits without incurring the cost of data development. This is an important benefit for collaborative GIS endeavors, and is the reason that partnerships can be a rewarding approach for GIS funding.

4.1.2 Costs versus Benefits

Four elements are required for a GIS program to exist in an organization: hardware, software, data and users. The specific benefits accrued will be dependent upon the data and software tools available, as well as the level of interest and education of GIS end users. While some task efficiencies can be achieved with basic GIS data and introductory knowledge of GIS by end users, other benefits may require more detailed data or customized analysis tools.

In order to realize the benefits of GIS it is necessary to invest in data collection. Software, hardware and staff are of minimal value on their own without the necessary data to support business needs. The value of the data is enhanced if the data is developed in accordance with an accepted set of standards. With wide acceptance of and use of standards a single investment in data development can provide benefits for multiple stakeholders. For existing data to retain its value it is necessary to invest in maintaining the data. If data are not maintained, not only are future benefits missed but the return on the initial investment in data collection is minimized. It is less expensive to manage and maintain data than it is to collect new data. Unfortunately, it is a frequent problem that resources are not allocated for data management and maintenance because the benefit is undervalued.



Once an investment is made in data collection some high value benefits can be accrued for a minimal relative investment by applying basic GIS functionality to support common needs such as query support and map production. While the quantitative benefit of these productivity tools may be low per use, they can provide significant value when summed over the number of uses. For example, GIS can save a planner an hour producing figures. If the planner makes 100 figures a year, this is 100 hours per year that the planner can use for other tasks.

By investing greater amounts of money in more sophisticated applications even greater benefits can be realized. For example the Maine Oil Spill Information System (MOSIS) is a special purpose application developed to enable multiple organizations to coordinate activities in the event of an oil spill. The value of GIS for such an application is that it can provide vital information such as infrastructure and plume modeling results to facilitate a rapid response to an oil spill event, resulting in the ability to better protect some of Maine's most valuable environmental and economic assets.

The benefit of geographic information technology is dynamic in nature. As additional efforts and resources are made available, additional benefits will accrue. With continued attention and support, benefits of GIS can continue and grow with the business needs of all levels of government. This report cites a number of initiatives and investments that have already been undertaken throughout the State. However, this does not imply that no further action should be taken. Rather, it is an indication that the State is ready to progress to the next level of GIS use, that of GIS collaboration and coordination.

4.2 Benefits of GIS by Constituency

4.2.1 State Benefits of GIS

GIS has a long tradition of use throughout Maine state government. In addition to MeGIS, many departments in Maine state government are heavy users. These include the Departments of Environmental Protection (DEP) and Transportation (DOT), Marine Resources (DMR), Emergency Management (MEMA), Conservation (DOC), Inland Fisheries and Wildlife (IF&W), the State Planning Office (SPO) and the Public Utilities Commission (PUC).

Many State GIS users develop and maintain independent data sets, in addition to obtaining data from MeGIS. By implementing a more coordinated state GIS program, synergies will exist enabling all departments to take greater advantage of the current level of investment in GIS by the State, and duplication of efforts can be reduced in data development and maintenance. To do this, standards need to be developed, and the infrastructure and policies for data sharing enhanced and formalized. In addition, staff are needed to manage and facilitate data sharing.

The following table lists state departments along with examples of general benefits from current and potential future deployment of GIS applications.

Department/Office	Application of GIS	Needs	Benefits
Transportation	Vehicle Routing	Roads and address data	Cost Avoidance - Reduced mileage, fuel usage and vehicle maintenance.
Environmental Protection	Permit review	Zoning, watershed, endangered species and natural resources data	Task Efficiencies – Reduced time to consider spatial criteria associated with permit approvals. Intangible – More complete consideration of multiple environmental criteria.
Economic Development	Site Selection, Marketing	Zoning, roads, utilities and parcel data and data standards	Task Efficiencies - Reduced time identifying appropriate locations for development. Intangible – Attract economic development by being proactive in presenting information.
Department of Education	School Redistricting	Schools locations and demographic data	Task Efficiencies – reduce time required to redistrict schools based upon population shifts. Cost Avoidance – prevent underutilization of schools. Intangible – Prevent school over-crowding.
Homeland Security and Emergency Management	Emergency Preparedness and Response	Infrastructure, state facilities, demographic data, data standards	Task Efficiencies – improve time to respond to emergencies such as power outages, floods. Intangible – better able to protect and serve residents during emergencies.
Safety/Police	Crime Tracking	Address data	Improved Service – by looking at the spatial distribution of crime, law enforcement can target policing efforts and protect most vulnerable members of the public such as school children and elderly.
Planning Office	Growth Management	Standards, technical assistance, data sharing policies	Cost Avoidance – minimize expenditures on grants that don't result in useable data. Improved Service – Can evaluate program efficiencies.

Historic Preservation	Tracking Properties	Locations of properties of archaeological and architectural significance.	Task Efficiencies – preparation of the Growth Management Architectural and Archaeological Sensitivity Areas maps would be reduced by automating map production in GIS. Intangible – Sharing information with communities and other planning and preservation organizations will help ensure inclusion of this information during the comprehensive planning process. This will improve the quality of these plans.
All Departments	Data Management	Data standards	Cost Avoidance - Elimination of redundancy of data collection and maintenance by centralizing.
	Mapping	Standards	Intangible - Standardize mapping and use of spatial data results in more confidence in information, and can improve decision-making.
	Coordinate Licensing	Staff person responsible	Cost Avoidance – reduce licenses purchased and under-utilized.
	Communications	Data, staff, software, hardware	Intangible – Improve ability to communicate issues and needs to stakeholders.
Insurance Industry	Flood Mapping	Flood Zone and parcel data	Cost Avoidance – by identifying areas of vulnerability, the industry can set its rates in the fairest way possible rather than spreading the cost across lower risk clients.

Some examples of specific state level benefits of GIS both in Maine and elsewhere are:

Maine Department of Health

The Maine Breast and Cervical Health Program (MBCHP) used state and federal GIS data to design and produce a set of maps to help MBCHP identify areas of unmet need for mammography and other women's health-related services. Address data from MBCHP was used to located and map existing care providers and community health coalitions. US Census Bureau population data were used to identify potential clients based on various age categories. The resulting maps were used by MBCHP to target future service locations and in proposals to procure federal funding. This work was completed for MBCHP by the local GIS consulting firm Northern Geomantics.

Maine Department of Transportation

By combining GIS enabled data from DOT and Inland Fisheries & Wildlife, DOT was able to map the incidents of animal crashes, particularly moose, across the state. This was valuable in demonstrating that the risk of being involved in an expensive, injurious crash in York County is as great as in the far off woods in the north. In addition DOT

finds GIS to be a valuable tool in communicating its resource and project needs to the Legislature, and for ensuring that all parts of the State receive an equitable distribution of funds.

Illinois State Police
GIS was used by the police department to examine traffic problems and develop more effective enforcement strategies that targeted specific areas and infractions. Implementation of a vigorous enforcement strategy dramatically reduced accidents by 42 percent compared to the previous year, and fatalities during the first half of the following year were down 29 percent.

North Carolina Department of Public Instruction
GIS was used for bus routing in the State's 107 school districts. Following a successful pilot program, the state mandated the use of GIS by all districts statewide in 1992 and provided state funding incentives. In the 1994-95 school year this resulted in the State's need for 500 fewer buses as well as a savings of 15,000,000 miles driven and 2,000,000 gallons of fuel over a six-year period of time.

4.2.2 Local benefits of GIS

GIS use at the local level usually begins with those departments that utilize maps as part of their regular business. The level of GIS use varies widely for those local governments in Maine that currently use the technology. Almost all towns with GIS find value in the ability to make maps to support traditional business needs, especially those that involve communicating with the public, governmental officials, and developers. However, there are local governments in Maine that have taken the use of GIS even further to the point where GIS is a fundamental tool in daily conduct of business.

There are a number of Maine municipalities that have made an investment in GIS including Freeport, York, Lewiston, Bath, Auburn and Portland. Many municipalities have linked GIS tax parcel maps with their assessing databases to further enhance the value of both sets of information, and others have implemented GIS across multiple departments. Auburn, for example, undertook a web-based implementation of GIS, providing departmental access to data and map-making tools on their Intranet. Implementations such as these provide the greatest benefit for the investment because the availability of maps and data eliminates the otherwise redundant efforts to create department or project specific versions of the same maps and data.

In these communities, the Assessing Departments, for example, have on-line access to the very same digital maps that the Engineering Department maintains. Assessing or Planning staff can quickly produce a map of abutters to a particular property, while engineering staff, using the same data, can produce a map for field crews to conduct home inspections for a neighborhood drainage improvement project. These examples demonstrate how GIS can become an invaluable tool for local government employees in managing and tracking information when given access to the information and appropriate training for its use.

Besides traditional GIS applications such as abutter lists, zoning maps and assessing applications, town-wide GIS implementations can provide access to information to support any business need that has a spatial component. For example, Lewiston is linking water quality monitoring information to their GIS in order to track the quality of water across the town. In Auburn, the Police department is applying GIS to crime analysis and mapping.

The following table shows examples of GIS applications from which different departments of local municipalities may benefit. The benefits are listed along with the data layers needed to support the applications described.

Department/Office	Application of GIS	Data Needed	Benefits
Public Works	Vehicle Routing	Roads, addresses	Cost Avoidance - Reduced mileage, reduced fuel usage, reduced vehicle maintenance
	Asset/Facility Management	Location of assets, asset characteristics	Task Efficiencies – Reduced time for planning large maintenance projects, timesaving in maintaining contract drawings and updating existing plans.
	Project Planning & Communications	Project specific data	Intangible – Assists in communicating project plans with municipal leaders and the public to obtain project support.
Assessor	Abutters lists	Parcels, ownership d+ata	Task Efficiencies - Reduced time in compiling abutters list
	Assessments	Parcels, attribute data on land and sales	Intangible – Greater equity in the distribution of tax assessments due to enhanced modeling and analysis capabilities.
Planning	Site Review	Zoning, roads, utilities, parcels	Task Efficiencies - Reduced time reviewing and approving plans submitted by developers.
	Map Preparation	All relevant layers	Task Efficiencies – Reduced time in preparing maps to support municipal boards and committees. Intangible – Assists in communicating issues and plans with municipal leaders and the public to obtain project support/issue resolution.
Economic Development	Site Assessment	Zoning, roads, utilities, parcels, environmental constraints	Task Efficiencies – Reduced time in selecting appropriate sites. Improved Service – Better able to respond to requests for new potential businesses and development. Intangible – Provides image of responsiveness to needs of business, which can attract economic development to appropriate areas.
Homeland Security and Emergency Management	Emergency Preparedness and Response	Infrastructure, state facilities, demographic data, data standards	Task Efficiencies – improve time to respond to emergencies such as power outages, floods. Intangible – better able to protect and serve residents during emergencies.

All Departments	Data Management	All relevant layers	Cost Avoidance - Elimination of redundancy of data collection and maintenance through centralization.
	Mapping	All relevant layers	Intangible - Standardize mapping and use of spatial data results in more confidence in information, and can improve decision-making.
	Data Query	All relevant layers	Task Efficiencies – Faster access to information since information is centrally located and accessible at the desktop. Cost Avoidance – Providing data to the public via the Internet can reduce the interruptions and time spent by town staff responding to requests for information.
	Decision Making	All relevant layers	Intangible – By applying thematic mapping and spatial analysis tools in GIS, a greater number of factors can be considered, leading to better informed decisions.

The total value of GIS to municipal government accrues through the cumulative value of many small benefits. A number of towns also realize intangible benefits such as improved decision making due to the ability to produce maps to support issues of concern. For example, the Town of Bath has noted a significant increase in the demand for GIS maps because these maps have added value, in fact have become invaluable, to the planning and decision making processes. Some other examples of specific local government benefits of GIS in municipalities in Maine and across the country are presented below. While some of these examples are anecdotal, they are representative of the variety of areas where the application of GIS provides value. They demonstrate that the investment in GIS can provide a net benefit from a variety of applications.

Westbrook, ME

By having sewer system data in GIS, the City of Westbrook was able to use GIS to access flow information. This resulted in an avoided cost of 16 person-hours of time for each trip to the field to collect flow data to open manhole covers and to observe direction of flow and pipe diameter. The sewer system has over 2,000 manholes. In addition, without GIS, staff needed to go to the original plans of the sewer system to obtain pipe information. These plans are difficult to locate in paper files, and sometimes the information on those plans is out of date or not legible. The GIS has more accurate data and frees up staff from fieldwork, allowing person-hours to be focused on other work.

The City also has a GIS layer of 2 ft. contours covering the entire city. This data layer, produced with a one-time capital outlay, continuously saves money on survey costs for construction projects, which are estimated to be between 5% and 10% of the total project costs. For example, if there is a $1 million project the survey cost on such a project is

usually between $50,000 and $100,000. This cost is avoided by using the GIS-based contour data instead of paying for additional survey work

Brunswick, ME
The Town of Brunswick is currently creating an open space plan and using GIS as part of this effort. There are approximately 100 volunteers working on this plan. These volunteers go out into the field to determine land use types. Approximately 3,000 person hours (about half the projected work time of the volunteers) was saved on this yearlong project by preparing for fieldwork through the analysis of land conditions and available open space using existing data sets in GIS.

There was also a survey of flora and fauna conducted as part of this project that required the use of a consultant to go into the field for identification. Approximately 50% of the estimated cost of the consultant was saved by using color aerial photographs with GIS software to determine this information and narrow down the area required for field effort.

Freeport, ME
The Town of Freeport has observed significant overall value in their use of GIS through an aggregation of a number of small benefits and efficiencies. For example, the Town receptionist has been given access to GIS tools and basic assessment data. As a result, the number of interruptions and the amount of time spent by the Assessor's office responding to requests for property information has been reduced. It is estimated that about a dozen requests for property data come in to the town each day. If there is a savings of 5 minutes per query by using GIS, this results in a savings of 5 hours a week, or 260 hours per year. While the town receptionist is performing new work more efficiently, the Assessor's office is freed to focus on their primary responsibilities. Additional savings have also been noted in the production of maps, in using GIS to reapportion voting districts, and in preparing mailing information to residents impacted by the Town's Browntail Moth Spray program. In aggregate, this results in months of savings per year.

Intangible benefits have also been noted by Freeport. Most notable are the new analysis capabilities that are added with GIS and the contribution of GIS to decision making. By improving the ability to communicate complex issues when a subject comes up for public debate, better decisions are made. Examples of GIS analysis functions that Freeport finds valuable include: plotting, viewing and basic visual analysis of property sales data; assessment of the factors that effect property values such as the proximity to specific natural (e.g. views, wetlands) and man-made assets (e.g. public sewers); and, providing the ability to measure the impact on property owners of proposed changes to zoning such as expansion of stream buffers.

Hampden, ME

The Town of Hampden recently completed a parcel map to help in planning projects. The parcel development allowed the planner to focus efforts on other projects rather than make maps for the planning commission meetings. The town estimates that the $10,000 spent to create the parcels was recovered in 2 years given timesavings based on the hours that the planner used to spend making maps for the planning commission alone.

St. Paul, MN
The City participated in the Local Update of Census Addresses (LUCA) program. This program allows communities to ensure that the Census Bureau has accurate information. The City used GIS and identified 1,099 housing units that the Census Bureau had not accounted for. The 2,900 people residing in the additional housing will result in the City receiving an additional estimated $5 million in federal funding over a ten-year period.

Marlborough, MA
The City of Marlborough estimates a cost savings of $50,000 per year by using it GIS data in lieu of survey contractors for public works projects.

City and County of Honolulu, HI
The city and county required maps and data to support facility maintenance management of the wastewater system. These maps were also required for master planning to support capital improvement program funding, planning, scheduling and tracking. GIS data sets were created of the sewer infrastructure facilities. These data support maintenance management, modeling and work order production. As a result of using the GIS data, the city and county avoided more than $6 million in federal fines. Additionally, more accurate assessments of capacity were created, a more efficient preventative maintenance management program was set up, and the city and county are able to take advantage of the GIS to more accurately forecast budgets for future projects.

4.2.3 Regional benefits of GIS

Regional use of GIS is valuable when it is necessary to compile information for multiple towns to facilitate planning, communications and decision-making. The application of GIS may be undertaken by an organization such as a regional utility, county government or council of governments, or informally by a group of towns deciding to work together on an initiative. Some examples of general benefits of GIS at the regional level are presented in the table below.

Department/Office	Application of GIS	Data Needed	Benefits
School Districts	Bus Routing	Roads, addresses	Cost Avoidance - Reduced mileage, reduced fuel usage, reduced vehicle maintenance
	School capacity planning	School locations, student addresses, demographic data.	Task Efficiencies – Reduced time for determining where students are located in relation to school capacities.
Councils of Government	Environmental Planning	Zoning, natural resources	Task Efficiencies - Reduced time to analyze multiple environmental criteria over a geographic region. Intangible – better planning and decision-making since environmental issues cross municipal boundaries.
Economic Development	Site Selection, Marketing	Zoning, roads, utilities, parcels, soils, environmental constraints	Task Efficiencies - Reduced time identifying appropriate locations for development Intangible – Able to attract economic development desired by a region by being proactive in presenting information.
All Departments	Data Management		Cost Avoidance - Elimination of redundancy of data collection and maintenance by centralizing.
	Mapping		Intangible - Standardize mapping and use of spatial data results in more confidence in information, and can improve decision-making.

The following are examples of typical regional government benefits of GIS as experienced in Florida and California:

Santa Clara County, CA

Santa Clara County implemented a study to determine the possible cost savings that could be achieved by implementing a multi-participant GIS system where several municipal, utility, and county agencies share the cost of data development and system maintenance. This study indicated that staff in numerous agencies at each level of government spend approximately $960,000 worth of time each year when preparing and manipulating maps to exchange data with other agencies. If data were exchanged electronically the County estimated that staff time would be reduced by 75 percent, resulting in an annual savings of $720,000. In addition, it was estimated that if all

agencies and departments used the same base map and map updates were coordinated to eliminate duplication of effort approximately $684,000 in map maintenance costs could be saved annually.

Duval County, FL
The County School District Transportation Department required improved school bus routing throughout the county. A GIS-based automated routing solution was implemented, resulting in the elimination of 20 bus routes. The elimination of these routes will save the school district an estimated $700,000 annually.

4.2.4 Benefits of GIS to Non Profit Organizations

GIS is also a valuable tool for applications outside of government. A variety of non-profit organizations in Maine have applied GIS to their projects. There is currently a high level of data sharing and partnering for data development between non-profits, colleges and universities and municipalities. Much of the data developed and shared, however, is not created to any specifications or standards. This can often limit the value of the data to the specific purpose for which they were created. The benefits of GIS to non-profit organizations are as varied as the organizations themselves. The following table presents some examples of the application of GIS to non-profit organizations in Maine:

Department/Office	Application of GIS	Data Needed	Benefits
Maine Audubon	Tracking Sprawl	Parcel data, Zoning data	Intangible – Better able to understand development patterns and develop strategies to influence behavior.
	Identify Potential Conservation Land	Landuse and parcel data, data from municipal comprehensive plans	Task Efficiencies – Reduced time to identify land to be acquired or protected frees up more time for decision making and taking actions. Intangible – Better able to coordinate land conservation efforts with comprehensive planning efforts of municipalities.
Island Institute	Communications and Scientific analysis	Sampling data, contours, data on habitats, coastline, parcel data and data from DEP	Intangible – Able to analyze and clearly integrate scientific and planning data, and communicate this in a form that can guide municipal planning and decision making, thus minimizing adverse impacts on island communities.
Maine Lakes Environmental Association	Analysis of Phosphorus loading	Landuse, phosphorus loading data	Intangible – Able to identify critical areas to effectively target mitigation efforts.
All	Data Management		Cost Avoidance - Elimination of redundancy of data collection and maintenance through centralization.
	Mapping		Intangible – Better able to present project specific information to constituents, resulting in more productive communications.

4.2.5 Benefits of GIS to Other Stakeholders

In addition to the specific benefits discussed above, the availability of GIS tools and data can benefit other stakeholders in Maine, including the private sector and the public. GIS is heavily used by some segments of the private sector including **telecommunications** and **utilities**. Individual companies invest significant amounts of money – up to millions of dollars - in the development of data sets for their own business purposes. The availability of specific digital municipal data, such as parcel data, through the GeoLibrary would increase the value of the private sector's GIS by enabling more detailed analyses of their service areas. For **consulting engineers** and **scientists**, the existence of standards and a catalog of data available in the GeoLibrary would enhance their ability to provide value added services to their clients by reducing the duplication of effort for project specific data development.

Other private business areas that would benefit from GIS include **realtors** and **developers**. Both of these groups use parcel data and other spatial data regularly as a part of normal business operations. With GIS, realtors will be better able to serve their clients by having the data and tools necessary to evaluate the multiple criteria that need to be considered when looking to buy, sell or develop a property. Similarly, developers spend a significant amount of time identifying appropriate sites for specific business opportunities. Not only will the GeoLibrary assist in the site assessment process, but the simple fact that all stakeholders in a development project will have access to the same data will result in improved communications. This can result in significant *cost avoidance* through the reduction of lengthy battles between developers, municipalities and the public over sites chosen by relying on incomplete information.

GIS is also an extremely powerful educational tool for Maine's students. By introducing GIS into classrooms at the elementary and secondary school levels, students can be guided to synthesize knowledge gained through specific classes and educational experiences. For example, students may study history, earth sciences and social studies. With GIS, information about historic sites, natural resources and demographics can be analyzed together to demonstrate to students the importance of geography and environmental factors in historic settlement patterns. In addition, exposure to GIS software strengthens general computer literacy.

Individual members of the public will also benefit from the use of GIS. By providing access to information and simple data viewing tools via the Internet, individuals with access to a PC at home, school or the library will be able to access information about their town, region or state by going to the GeoLibrary. This will improve the public's ability to participate in public debate, and to influence decision making that affect their quality of life. Further, it saves individuals the time that would be associated with collecting this information from state agencies or public libraries.

4.2.6 Collaborative Benefits of GIS

GIS is used in Maine at the local, regional and state government levels, and at each level there are a series of benefits that can, and have been realized. However, some of the most valuable benefits of GIS are not realized within any one level of government. Collaborative GIS initiatives that involve a variety of participants provide a great deal of value through the coordinated development and use of GIS data. With collaboration it possible to avoid the duplication of effort that can occur when multiple organizations develop similar data independently. The primary benefits associated with collaborative GIS initiatives are those of leveraged investments.

GIS consists of a number of layers of data. Each layer of data has value of its own, but the value of multiple layers can be greater than the sum of the individual layers. This is true because of the powerful analysis and decision support capabilities of GIS. For example, data about the location of roads are widely used across all levels of government for setting the context of a geographic area or determining the best route from one point to another. Parcel data is useful for observing the distribution and ownership of land, and

zoning data identifies how land can be used. Any of these sets of data in GIS are useful for observing specific categories of information. However, when these three data layers are combined the information can be used by a number of different organizations and groups for many purposes. A transportation department may use the data to estimate the number of parcels that would be impacted by a new road project, an economic development agency can use the data to target the most appropriate parcels to market to new businesses, and a town can use the combined information to determine if zoning should be changed.

Site assessment and site selection for all purposes is a valuable application of GIS. In addition to economic development, GIS has been used to identify the most appropriate location of public and private facilities. By combining local information about parcels and zoning with regional utility data and the location of public services, GIS can dramatically decrease the time it takes to locate facilities such as new police and fire stations, libraries, health care centers and schools. In North Carolina, GIS was used to analyze potential locations for a new fire station. With the support of GIS the decision was made to relocate two existing stations rather than adding a new station. The result of this decision and action was a reduction in fire department response time from 7 minutes to 4 minutes, and a savings of an estimated $2,000,000 in building costs, equipment and salaries over 5 years.

Some specific examples of the benefits of collaborative GIS are presented below.

Homeland Security
The United States Federal Geographic Data Committee (FGDC) has determined that GIS is an invaluable tool for the handling, display, and analysis of information involved in every aspect of Homeland Security. It is not possible to address the issue of Homeland security without crossing geographic, governmental and professional boundaries. It is only by collaborating that public safety and assets can be adequately protected. The FGDC indicates that GIS is useful on many levels. For example:

- **Detection:** GIS information provides the spatial and temporal backdrop upon which effective and efficient threat analysis is accomplished. By linking and analyzing temporally and spatially associated information in real time, patterns may be detected that lead to timely identification of likely modalities and targets. This type of approach has been applied recently in the Greater Chicago area.
- **Preparedness:** Emergency planners and responders must often depend on geospatial information to accomplish their mission. Current, accurate information that is readily available is crucial to ensuring the readiness of teams to respond. GIS information access and interoperability standards are essential elements as they support the means for the local, state and federal response units to react to terrorist attacks, natural disasters, and other emergencies.
- **Prevention:** GIS information provides a means to detect and analyze patterns regarding terrorist threats and possible attacks. This information, coupled with

information about borders, waters, and airspace, in turn may lead to the disruption of their plans or the prevention or interdiction of their attacks.

- **Protection:** GIS information is a very important component in the analysis of critical infrastructure vulnerabilities and in the use of decision support technologies such as visualization and simulation to anticipate and protect against cascading effects of an attack on one system as it relates to other interdependent systems.
- **Response and Recovery:** GIS information has been used by many organizations in response to and recovery from natural disasters. Similarly, this information is invaluable for emergency response services of all kinds, as well as for carrying out long-term recovery operations. GIS has been applied extensively in New York City to support the response and recovery efforts following the attacks on the World Trade Center.

Maine's Beginning with Habitat Project

The Maine State Planning Office (SPO) in collaboration with the Maine Department of Inland Fisheries and Wildlife (MDIFW), Maine Natural Areas Program (MNAP), US Fish and Wildlife Service (USFWS), Maine Audubon Society (MAS), Wells National Estuarine Research Reserve, and the Southern Maine Regional Planning Council (SMRPC) are working together to develop and pilot a new approach toward town and regional open space planning.

In order for communities to grow in a manner that promotes conservation and protection of critical natural resources, towns need access to current resource information. The "Beginning with Habitat" project focuses on 10 -14 towns in Southern Coastal Maine to promote a greater local understanding of the need to conserve biological diversity and to provide useful tools to these towns which will help them chart their future growth. For each of the pilot towns a series of digital and hard copy maps, with supporting information, will be developed which identifies 1) habitats of management concern as identified by MDIFW, MNAP, and USFWS; 2) riparian, wetland and open water areas which need to be conserved to maintain habitat connectivity and integrity in a developing landscape; and 3) large undeveloped blocks of regional significance. Information on wetlands, watershed boundaries, conservation ownership, and landuse will also be provided. Technical assistance will also be provided to help towns analyze the data and incorporate it as appropriate into comprehensive and open space planning.

The result of this effort will be the enabling of local, regional, state and federal entities to adopt a proactive strategy of sharing information and technical expertise, and improving planning and decision-making. The response to this project from the natural resource community, the planning community, towns, land trusts, and others has been overwhelming. What has become enormously evident is that this work is extremely timely and important as towns face the pressure of increased growth and development and work to maintain the natural character of their communities.

Maine's E911 Project
The Maine Office of GIS is collaborating with the Department of Public Safety and municipalities throughout Maine to develop road centerline data as part of the E911 project. This project provides valuable data that can be used to associate addresses with spatial road data. The project has been funded through a combination of bond funds and a telephone surcharge, with participating towns providing in kind services to review, edit and update data. The resulting data has and will provide recognizable benefits to the majority of GIS users in Maine. This is a good example of a data development project that provides benefits through multiple levels of government as well as the private sector with one targeted application of resources.

The street centerline data has been used by municipalities such as Bath to map sidewalks and develop maps to facilitate decision-making about maintenance activities. Having access to this data has saved time in producing the maps needed to support this process, and has enabled Bath to present more maps for communication and review than would have been possible with a paper based system. Other uses of street centerline data from this project include (a) geocoding of lead information by Maine State Housing to target educational literature and service needs and (b) school bus routing by the Department of Education to improve the efficiency of miles traveled in school districts across the State.

Michigan
During the summer of 1996 the Michigan Departments of Transportation, Natural Resources, State, and Management and Budget voluntarily came together to pool their resources to create a single, up-to-date, accurate, statewide base map and associated applications. Michigan estimates that this approach saved the State over $15,000,000, or 50% of the cost, for the development of the basemap compared to the aggregated cost of data development by each department. In addition, the project has provided a focal point for establishing partnerships between federal, state, regional, county and local agencies and improving communication among agencies involved in geographic information management.

4.3 Description of Benefits by Recommendations Made in the Coordination & Implementation Plan

Pillar #1: Standards
Standards for the development of spatial and associated attribute data and metadata are necessary to ensure the highest return on investment in data creation and maintenance. A significant amount of resources are spent throughout the State on the development of digital spatial data, however there are no standards in place to ensure that the data will have value for purposes other than the specific use for which they are created.

The State Planning Office has awarded about 400 planning grants totaling $1.2 million for the development of GIS, including development of digital parcel data. In addition, $100,000 has been spent on 225 implementation grants to develop land use and zoning data. If statewide GIS standards are developed, these investments can be leveraged into

the core of a consistent, statewide land records mapping and analysis system that will accrue both economic and environmental benefits to the state. Similarly, standards will enable data produced by colleges and universities to be incorporated into the statewide data sets, enhancing the value of academic contributions to the state data reserves.

Similarly, when land surveys are done for public projects, the spatial data are developed in an assumed coordinate system rather than a standard coordinate system such as State Plane meters or UTM unless there is a specific requirement otherwise. This means that it is not possible to precisely associate these data with other spatial data sources. The existence of standards will enhance the return on investment in data development by ensuring that all spatial data that is created can be shared and combined with other data.

When municipalities hire a consultant for a transportation project, environmental assessment, or other projects, spatial data may be required for analysis of the issues. If existing spatial data do not have metadata, consultants will not have confidence that the existing data are appropriate for use, and will develop new data. This cost is incurred by each municipality. Costs of developing new data could be reduced if existing data were well documented and conformed to standards.

Pillar #2: Expanded Data Warehousing

A key goal Maine's statewide GIS expansion is to create the Maine Public Library for Geographic Information. By improving the State's GIS infrastructure all of the state's data can be collected and made available through the Library, providing one-stop shopping for access to Maine's spatial data. Making access easier and more efficient will lead to increased use of data for multiple purposes, and a greater return on investment.

In addition, the existence of the Library will save individual State agencies the time and effort required to respond to multiple requests for data. The Department of Transportation estimates that it requires 10% of a full time equivalent employee to service requests for road data from other state agencies, consultants, federal agencies, regional planning commissions, towns, utilities, and map companies. Aggregating requests for specific data sets across all State departments that use GIS can easily add up to a full time employee. If data requests to municipalities and regional organizations across the State are considered also, the time of multiple full time employees can be saved and used for more valuable tasks.

Perhaps the greatest benefit of the Library will be a reduction in the duplication of similar data sets across the State. It is often the case that data sets are developed from scratch because nobody is aware that a data set may exists elsewhere, or they cannot access an existing data set in a way that is easy for them to use. The Library will alleviate this. Some key data sets, for example, are maintained by multiple State agencies. Road centerline data are maintained by both DOT and the E911 program and hydrologic and drainage divides are kept by various state agencies. This is not only a duplication of effort, but it is also a burden to potential users who may become confused or frustrated in attempts to understand differences in data quality, content and availability. By

consolidating these data in the Library, the time spent on data maintenance is reduced to a fraction of the cost and data quality will improve.

An important intangible benefit of the GeoLibrary is its ability to provide common data for use by all stakeholders, including state and local decision makers, non-profit organizations, the private sector and the public. This will ensure that everyone involved in addressing an issue of public concern will have access to the same information to perform independent analyses and assessments, thus "*leveling the playing field"* with regard to data access. The value of this is that it empowers stakeholders to inform themselves, and can elevate the level of debate. This may ultimately assist in achieving consensus or in formulating compromises necessary to move projects forward.

Pillar #3: Statewide Data Development

The Needs Assessment indicated that there is wide need for several important data sets that are currently unavailable, including: parcels, zoning, protected open space and land cover. These data are necessary to provide efficiency benefits to all level of government, as well as to enhance current GIS capabilities.

Recognizing that developing high-quality local data sets requires access to consistent, high-quality base mapping. It would be beneficial for the State to actively work with the USGS by providing matching funds for the National Aerial Photo Program (NAPP). Maine's investment in new orthophotographs could leverage up to $1.6M of USGS funding to create an improved base map for the State. This would underpin much of the new parcel and zoning development that can provide value in the coming years.

The development of land cover data will contribute to the value of many types of GIS applications including growth management and watershed protection. Statewide land cover data will be valuable across all levels of government and the private sector for site assessment and site selection applications, as well as for tracking development and environmental impacts.

Zoning data is maintained by individual municipalities, many of which use town and city specific zoning codes. By providing grants to standardize the codes and aggregating these data in the Library, statewide zoning data will provide value to regional and state organizations for planning and environmental protection efforts, as well as for targeting and attracting economic development.

One of the most valuable data sets across all levels of government and the private sector is parcel data. Encouraging and supporting a standard approach to parcel development that is adoptable by each municipality will benefit State agencies, counties, utilities and the private sector. At this time, organizations such as the Department of Marine Resources, Portland Water District and regional Councils of Government needing parcel data for a region must contact individual municipalities, and then spend the time pasting data sets together for regional consideration. Not only does the pasting process yield inconsistencies and data gaps, but the total time required by each requesting organization

may be 60 hours per use, depending on the geographic extent of the area, adding up to a significant amount of time when the number of public and private organizations making requests is aggregated. Furthermore, after such an effort is made there is typically no means of keeping such a valuable data set updated so that it retains its utility going forward. In addition, digital parcel data does not exist for many towns, leading to incomplete analysis of some areas.

Statewide parcel data would provide value for a number of applications such as development tracking and economic development. In addition it can provide task efficiencies across all levels of government. At the local level, digital parcel data enables an Assessor to cut the time required to complete a single abutters list from hours to minutes. This savings can also be realized by State agencies needing to contact residents about a new road development project, or in the event of an emergency such as a gas explosion or environmental concern. Over a year this can add up to hundreds of hours.

Pillar #4: Application Development

There are a number of potential GIS applications that will have wide applicability for current and future GIS users in Maine. Priority public sector use areas identified in this study include development tracking, environmental protection, economic development and homeland security, but the greatest benefits will be realized through the establishment of statewide standards and coordination Once data are developed, the maximum value of the data is realized in its use for analysis and communications. For example, both homeland security and environmental protection applications for GIS that utilize up-to-date data in the Library would enable local, regional and federal public safety officials to respond in almost real time to emergency situations. In addition, it will assist in planning and preparing for events by providing the ability to model different scenarios and actions to be taken. All this will ultimately result in improved public safety and protection of Maine's environmental assets.

The creation of an economic development application can benefit local, state and private organizations by assisting in the assessment of sites for development. South Carolina has actively used GIS to market locations across the state for business development and has been highly successful in attracting new businesses and the tax dollars that they bring.

A development tracking application will measure the change in landuse brought about by human development. Quantifying this change is essential to assessing evolving needs in infrastructure planning and environmental management. The State of Maine currently has no uniform and consistent method of capturing these changes. The value of such an application is that it will enable towns, State agencies and utilities to proactively assess, plan for and coordinate future development.

Pillar #5: Outreach, Education and Coordination

Providing outreach and support to GIS users in Maine will ensure that they get the most of existing and future investments in GIS. Currently, some GIS users in the State do not

utilize software and data to which they have access because they are unable to overcome simple technical hurdles. For example, some towns do not know how to change the projection system of GIS data layers so they do not take advantage of some data sets that already exist.

Currently, most data collected as part of survey and engineering work done locally is not usable in GIS because of a lack of data development standards and the absence of simple requirements that data be submitted digitally. The development of boilerplate language and standards for data development should assist in growing municipal data sets over time.

By providing staff to educate GIS users about data development, standards and technical issues, municipalities can capitalize on investments made in GIS. Some municipalities have GIS software and have paid to have data developed, but the data are not being used. This represents a lost investment of thousands of dollars for some towns because of lack of staff and/or expertise. By establishing an outreach network and developing standards and some basic publications about GIS, stranded investments can be minimized.

4.4 Business Justification for Development of The Maine Public Library of Geographic Information

This report presents many examples of GIS use and benefits in Maine and in other states with relevant experience. The information in this report was compiled from a number of sources including direct experiences with organizations using GIS, published materials and interviews and personal conversations with GIS users in Maine. As presented in Section 4.1, there are five general categories of benefits that Maine could realize with an enhanced GIS program:

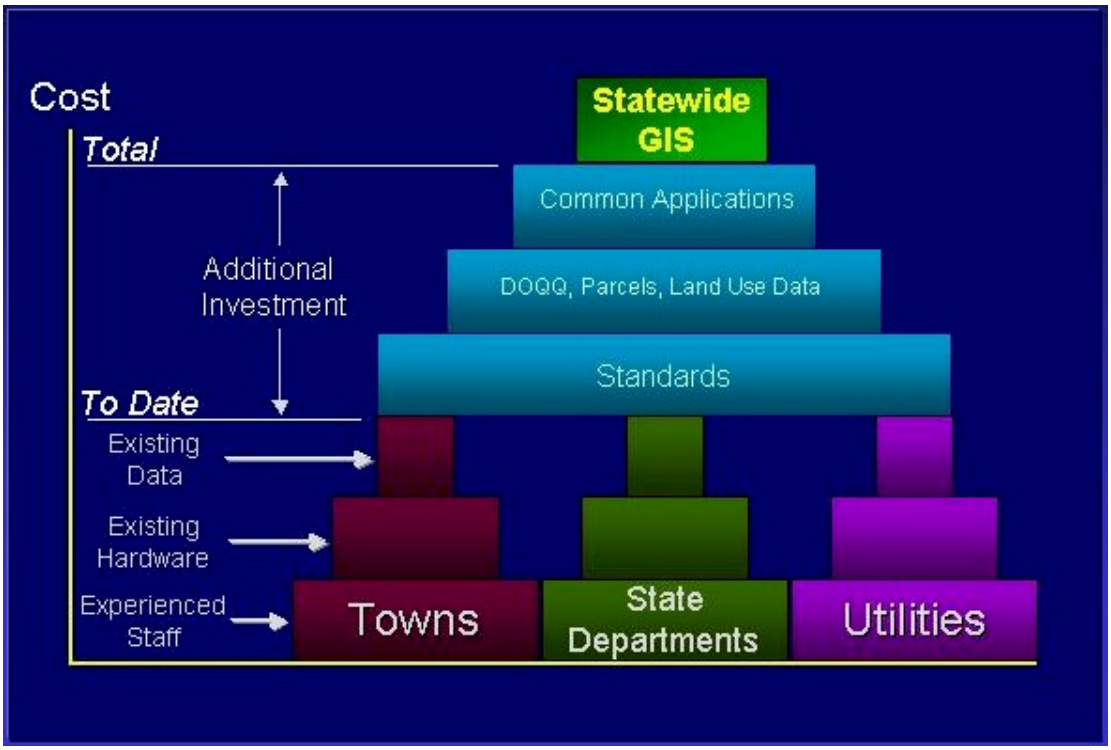
- Task Efficiencies
- Cost Avoidance
- Improvements and Additions to Service
- Intangible Benefits
- Leveraged Investment

Examples of all of these types of benefits have been presented in Section 4.2. Based upon these examples, the following table summarizes the benefits that Maine can expect from an investment in an enhanced statewide GIS program. The aggregation of the information in this table demonstrates that Maine can realize millions of dollars in benefits for state and local government, as well as for the public, by taking action on the recommendations in this report. Maine can expect some specific quantifiable benefits by implementing the recommendations in this report, these are described in the text following the table.

Benefit Type	Application of GIS	Magnitude of Benefit
Task Efficiencies		
	Site Assessment	Days of time per use by state, regional, local and private organizations.
	Abutters lists	Days of time per use for all municipalities in Maine.
	Production of graphics	Weeks of time per year for all municipalities and many state agencies.
	Permit review	Weeks of time per year for DEP.
	School redistricting	Weeks of time per project for DOE and school districts.
	Political redistricting	Weeks of time per project.
Cost Avoidance		
	Vehicle Routing	Potentially millions of vehicle miles traveled, at 36.5 cents per mile, by school districts, local DPWs, state DOT.
	Duplication of effort for data development and maintenance	Thousands of dollars a year for state agencies.
	Software licensing	Thousands of dollars per year for municipalities and state agencies.
	Support for data sharing	Weeks per year for DOT and DEP, days per year for municipalities with digital parcel data.
Improvements and additions to service		
	Targeted police efforts from crime analysis	Reduced crime resulting greater public safety.
	Faster emergency response times	Saves lives and protects valuable assets.
Intangible Benefits		
	Improved decision making	Better confidence in public and improved quality of life.
	Attraction of new business	Increased tax revenues and employment rates.
	Prevent loss of data	Potentially millions of dollars of paper records.
	Improve public health	Target health services and education based upon spatial distribution of population.
	Improved education of students	Introduction of GIS in schools provides tools for students to synthesize knowledge about geography, social studies, mathematics and computers, and to actively pursue knowledge about their state.
Leveraged Investment		
	Grant money for planning	$1.5 million over ten years of SPO grants.
	USGS NAPP funding	$1.6 million for development of ortho-photography.
	Local land survey data	Thousands of dollars for data development per town in Maine.
	Prevent loss of data	Potentially millions of dollars of paper records.
	Ability to make case for grant funding	Potentially thousands of dollars in grant funding.
	Future data development	Potentially millions of dollars for data development by municipalities and state agencies.

As discussed throughout this report, there are many successful applications of GIS in Maine at this time. Approximately $20 million dollars has been invested by the state in GIS data and application development since the early 1990's, and currently roughly $2 million is spent annually to maintain the current infrastructure. Additional millions more have been invested by local governments such as Lewiston, Auburn, York and Portland, with hundreds of thousands of dollars being spent by municipalities across the state to maintain GIS assets. The result is a solid foundation of GIS knowledge, data and tools.

The actions proposed in this report have been formulated to enable Maine to leverage this investment. The Maine Public Library of Geographic Information will provide the capacity and infrastructure to give broader access to Maine's existing state, regional and local GIS data. In addition, through the creation of standards, new data that is developed over time can be stored in the Library and made available and useful to a wider base of users. The benefits will therefore have a multiplying effect. The graphic below shows how the independent efforts of different entities when combined with strategic ***statewide investment*** can result in the efficient creation of a true statewide system.



For example, if a town hires an engineer to do a land survey of a specific area, and the new data standards are applied, these data can be brought into the Library. Then, if a utility is called in to do work on the site as a result of development, the cost of collecting new redundant data is saved. Without the standards and the Library it would be necessary to recreate these data because the utility would either not know of the existence of this data, or would not have confidence in its use because of lack of standards. Rather

than providing benefits only for the specific site assessment purpose for which the data set was collected, the life and value of the data is extended, resulting in a multiplication of benefits. If a single site survey cost $1,000, and a town has 5 surveys done a year, this is $5,000 per year, per town. This is a lost investment in spatial data development because of the lack of standards and a lack of an infrastructure such as the Library for sharing these data.

Similarly, as noted in Section 4.3 the State Planning Office (SPO) estimates that approximately $1.5 million in grant moneys given by the state over the last 10 years *could* have produced a higher return on investment if GIS data standards were in place. With standards and the Library, the grant moneys provided by SPO to assist communities in developing data for comprehensive planning would have provided additional value for current and future use at all levels of government. Since the comprehensive planning program will continue over time, there is an opportunity to capture this additional value for all *future* SPO grants.

The existence of the GeoLibrary will also save Maine the cost of duplicated efforts for data development and maintenance. For example, it is currently costing Maine double what it could to maintain street centerline data since this is done both by DOT and for the E-911 program. Similarly, multiple agencies spend time maintaining hydrologic and drainage divides data when it can be streamlined to a fraction of the effort by having the data located in a central repository. To accomplish this, a committee could be formed for each duplicated data set to determine which is of the highest quality and value to the most end users. This would then be designated as the master data set, and the responsibility for editing the data placed upon the individual or individuals that are most appropriate.

The GeoLibrary will also provide the benefit of avoided costs of sharing data. DOT estimates that it requires about 10% of a full time equivalent employee to respond to road data requests. By combining data requests to all state agencies and serving them with the Library, this staff time can be saved and used to support the Library and similar statewide GIS coordination and outreach endeavors instead. Similarly, towns and regional councils of governments (COGS) service a number of data requests and COGS also spend time compiling GIS data for municipalities in their jurisdiction. This staff time could also be redirected to support the needs of the Library, or can be spent on more worthwhile activities at the local level.

As part of the GeoLibrary, it is recommended that Maine work toward the development of digital parcel data statewide. These data would be valuable to all Maine organizations, public and private, that have GIS. For example, the collaborative Beginning with Habitat project discussed in Section 4.2.4 involves the compilation of many environmental data layers to aid towns in proactive planning. While these data are valuable in understanding environmental issues and threats, the availability of parcel data in combination with the Habitat data would bring the benefits of this program to a new level. This would give local regional, state and federal decision makers the ability to place environmental assets in context with existing property information, thus empowering them to make better-informed decisions.

The Town of Hampden estimated that the $10,000 cost of developing digital parcel data was paid back in 2 years based only on the time it saved the Town Planner to produce maps. If the benefits of this data for other town, regional, state and private uses were considered, the time to recover the cost of the investment would be even shorter. This benefit will be magnified further the more municipalities develop digital parcel data that conform to statewide standards, and place the data in the Library.

In addition to adding value to the existing foundation data, having statewide parcels in the Library will save time across all levels of government for data sharing. Many state and regional agencies require parcel data for regions of Maine. In order to compile this data it is now necessary to contact all towns in the target region and manipulate the data from each so that it can be spatially aggregated. In many cases updated digital data are not even available. This type of activity is undertaken many times each year by organizations all over Maine.

Finally, outreach and technical assistance is needed to support end users of the Library, especially those that are new to GIS, or that are unsure of how to take advantage of this asset. Municipalities in Maine have spent thousands of dollars over the last decade on GIS data and software that sit unused and un-maintained. This investment is wasted because of a lack of understanding about how the data can be used, as well as because staffs do not have the time to overcome simple technical issues associated with the application of GIS.

4.5 Summary

Use of GIS in the public sector will grow in Maine over the coming years as individual organizations make investments in data, training and GIS infrastructure. Now is the time for the state to invest in efforts to coordinate these activities before opportunities for maximizing the collective investment of public funds are missed. It is not a question of whether GIS will be used in Maine; it is a question of how effectively the resources will be applied. The programs presented in this report will provide the coordinating mechanisms to maximize the return on the States expenditures on GIS.